Abdul Basit (Notre Dame)
Rank Bounds for Design Matrices and Applications.

A (q, k, t)-design matrix is an m by n matrix whose pattern of zeros/non-zeros satisfies the following design-like condition: Each row has at most q non-zeros, each column has at least k non-zeros and the supports of every two columns intersect in at most t rows. Dvir–Saraf—Wigderson showed a lower bound of $n - ntq(q-1)/k$ on the rank of such matrices over fields of characteristic zero (or sufficiently large finite characteristic). Rank bounds of design matrices have been used to study various problems in discrete geometry, such as rigidity theory, geometric incidences and Sylvester–Gallai type problems. In this talk, I will give a survey of the method as well as some of its applications.

Saugata Basu (Purdue)
Quantitative bounds on the topology of semi-algebraic and definable sets.

I will survey some old and new results on bounding the topology of semi-algebraic and definable sets in terms of various parameters of their defining formulas, and indicate how some of these results impact problems of discrete geometry over the reals. If time permits I will pose some open questions as well.

Martin Bays(Münster)
Pseudo-finite dimensions, modularity, and generalisations of Elekes–Szabó.

Given a system of polynomial equations in m complex variables with solution set V of dimension d, if we take finite subsets X_i of $\mathbb{C}$ each of size N, then the number of solutions to the system whose i-th co-ordinate is in X_i is easily seen to be bounded as $O(N^d)$. We ask: for what V is the exponent d in this bound optimal?

Hrushovski developed a formalism in which such questions become amenable to the tools of model theory, and in particular observed that incidence bounds of Szemerédi–Trotter type imply modularity of associated geometries, allowing application of the group configuration theorem. Exploiting this, we answer the question above, and treat a higher dimensional version. This generalises results of Elekes–Szabó on the case ($m = 3$,$d = 2$).

Part of a joint project with Emmanuel Breuillard.

Artem Chernikov(UCLA)
Model-theoretic distality and incidence combinatorics.

In this talk I will give an overview of some recent developments on the interplay of model theory, hypergraph regularity and incidence combinatorics. We will focus on the notion of a distal structure and its local variants, which provide an abstract setting for “characteristic 0” incidence combinatorics. In particular, I will present joint work with David Galvin and Sergei Starchenko on generalizing various incidence bounds (e.g. the Szemerédi–Trotter theorem, strong Erdős–Hajnal property, etc.) from the semialgebraic setting to arbitrary distal structures (which includes o-minimal structures, p-adics, etc.).

Gabriel Conant (Notre Dame)
Stable and NIP regularity in groups.

We use local stability theory to prove a group version of Szemerédi regularity for stable subsets of finite groups. Toward generalizing this result to the NIP setting, we consider definable set systems of finite VC-dimension in pseudofinite groups. In this case, many tools and results from groups definable in NIP theories can be localized, and we study group-theoretic versions of Szemerédi regularity which can be shown using these methods.

Joint with A. Pillay and C. Terry.

Mauro Di Nasso (Pisa)
Using nonstandard natural numbers in Ramsey Theory.

In Ramsey Theory, ultrafilters often play an instrumental role. By means of nonstandard models, one can reduce those third-order objects (ultrafilters are sets of sets of natural numbers) to simple points. In this talk we present a nonstandard technique that is grounded on the above observation, and show its use to prove new results in Ramsey Theory of Diophantine equations. In this field, one investigates whether a given equation is partition regular on $\mathbb{N}$ (that is, there exist monochromatic solutions in every finite coloring of $\mathbb{N}$).

Mirna Džamonja (East Anglia)
Absolute notions in model theory.

The wonderful theory of stability and ranks developed for many notions in first order model theory implies that many model theoretic constructions are absolute, since they can be expressed in terms of internal properties measurable by the existence of certain formulas. However, it is not at all the case that all natural model-theoretic notions are absolute. Our talk will survey some known results about absoluteness and ask some new questions.

David Evans (Imperial)
Automorphism groups and Ramsey properties of sparse graphs.

An infinite graph is sparse if there is a positive integer k such that for every finite subgraph, the number of edges is bounded above by k times the number of vertices. Such graphs arise in model theory via Hrushovskis predimension constructions. In joint work with J. Hubička and J. Nešetřil, we study automorphism groups of sparse graphs from the viewpoint of topological dynamics and the Kechris, Pestov, Todorcevic correspondence. We investigate amenable and extremely amenable subgroups of these groups using the 'space of k-orientations' of the graph and results from structural Ramsey theory. In particular, we show that Hrushovskis example of an omega-categorical sparse graph has no omega-categorical expansion with an extremely amenable automorphism group, thereby providing a counterexample to a conjecture in the area.

Timothy Gowers (Cambridge)
A quantitative inverse theorem for the U^4 norm over finite fields.

The U^4 norm is one of a sequence of norms that measure ever stronger forms of quasirandomness. The structure of bounded functions whose U^k norms are within a constant of being as large as possible has been the subject of a lot of research over the last twenty years, and has applications to results such as Szemerédi's theorem and the Green–Tao theorem. Qualitatively speaking, there is now a complete description of such functions when they are defined on $\mathbb{F}_p^n$ (a result of Bergelson, Tao and Ziegler) and $\mathbb{Z}_N$ (a result of Green, Tao and Ziegler). I shall describe recent work with Luka Milićević in which we obtain quantitative bounds for the first case where these were not known, namely for the U^4 norm and for functions defined on $\mathbb{F}_p^n$.

Jan Hubička (Charles U.)
Ramsey theorems for classes of structures with functions and relations.

We discuss a generalization of Nešetřil-Rődl theorem for free amalgamation classes of structures in a language containing both relations and partial functions. Then we further strenghten this to Ramsey theorem for amalgamation classses satisfying additional condition on completion of incomplete structures into the class and discuss connections to Stationary Independence Relation and Extension Property for Partial Automorphisms. There results have several applications including optimal Ramsey expansions of classes obtained by Hrushovski predimension construction and of generalized metric spaces.

This is joint work with David Evans, Matěj Konečný and Jaroslav Nešetřil.

Peter Keevash (Oxford)
More designs

We generalise the existence of combinatorial designs to the setting of subset sums in lattices with coordinates indexed by labelled faces of simplicial complexes. This general framework includes the problem of decomposing hypergraphs with extra edge data, such as colours and orders, and so incorporates a wide range of variations on the basic design problem, notably Baranyai-type generalisations, such as resolvable hypergraph designs, large sets of hypergraph designs and decompositions of designs by designs.

Alex Lubotzky (Hebrew U.)
First order rigidity of high-rank arithmetic groups.

The family of high rank arithmetic groups is a class of groups playing an important role in various areas of mathematics. It includes $SL(n, Z)$, for $n > 2$, $SL(n, Z[1/p])$ for $n > 1$, their finite index subgroups and many more. A number of remarkable results about them have been proven including; Mostow rigidity, Margulis Super rigidity and the Quasi-isometric rigidity.

We will talk about a new type of rigidity : "first order rigidity". Namely if G is such a non-uniform characteristic zero arithmetic group and H a finitely generated group which is elementary equivalent to it then H is isomorphic to G.

This stands in contrast with Zlil Sela's remarkable work which implies that the free groups, surface groups and hyperbolic groups (many of which are low-rank arithmetic groups) have many non isomorphic finitely generated groups which are elementary equivalent to them.

Joint work with Nir Avni and Chen Meiri.

Maryanthe Malliaris (Chicago)
Combinatorics and saturation.

Saturated models are in some sense complete, containing all of their limit points, suitably defined. The talk will be about how combinatorial properties of theories affect the construction of saturated models, especially in simple theories, a class including the random graph and the random tetrahedron-free three-hypergraph.

Dhruv Mubayi (UI Chicago)
New Developments in Hypergraph Ramsey Theory.

I will describe lower bounds (i.e. constructions) for several hypergraph Ramsey problems. These constructions settle old conjectures of Erdős–Hajnal on classical Ramsey numbers as well as more recent questions due to Conlon–Fox–Lee–Sudakov and others on generalized Ramsey numbers and the Erdos–Rogers problem.

Most of this is joint work with Andrew Suk.

Jaroslav Nešetřil (Prague)
Ramsey classes and sparsity for finite models.

In the talk we relate two notions in the title particularly in the context of sparse dense dichotomy (nowhere and somewhere dense classes and stability) and Ramsey classes of finite models in the context of the characterisation programme. A joint work with P. Ossona de Mendez (sparsity) and D. Evans and J. Hubička (Ramsey).

Patrice Ossona de Mendez(EHSS)
Modeling limits.

A sequence of graphs is FO-convergent if the probability of satisfaction of every first-order formula converges. A graph modeling is a graph, whose domain is a standard probability space, with the property that every definable set is Borel. It was known that FO-convergent sequences of graphs do not always admit a modeling limit, and it was conjectured that this is the case if the graphs in the sequence are sufficiently sparse. Precisely, two conjectures were proposed:

1) If a FO-convergent sequence of graphs is residual, that is, if for every integer d the maximum relative size of a ball of radius d in the graphs of the sequence tends to zero, then the sequence has a modeling limit.

2) A monotone class of graphs $\mathcal{C}$ has the property that every FO-convergent sequence of graphs from $\mathcal{C}$ has a modeling limit if and only if $\mathcal{C}$ is nowhere dense, that is, if and only if for each integer p there is $N(p)$ such that the pth subdivision of the complete graph on $N(p)$ vertices does not belong to $\mathcal{C}$.

In this talk we present the proof of both conjectures. This solves some of the main problems in the area and among others provides an analytic characterization of the nowhere dense–somewhere dense dichotomy.

János Pach (EPFL Lausanne and Renyi)
Let's talk about multiple crossings.

Let $k > 1$ be a fixed integer. It is conjectured that any graph on n vertices that can be drawn in the plane without k pairwise crossing edges has $O(n)$ edges. Two edges of a hypergraph cross each other if neither of them contains the other, they have a nonempty intersection, and their union is not the whole vertex set. It is conjectured that any hypergraph on n vertices that contains no k pairwise crossing edges has at most $O(n)$ edges. We discuss the relationship between the above conjectures and explain some partial answers, including a recent result of Kupavskii, Tomon, and the speaker, improving a 40 years old bound of Lomonosov.

Micha Sharir (Tel Aviv)
The Algebraic Revolution in Combinatorial and Computational Geometry: State of the Art.

For the past 10 years, combinatorial geometry (and to some extent, computational geometry too) has gone through a dramatic revolution, due to the infusion of techniques from algebraic geometry and algebra that have proven effective in solving a variety of hard problems that were thought to be unreachable with more traditional techniques. The new era has begun with two groundbreaking papers of Guth and Katz, the second of which has (almost completely) solved the distinct distances problem of Erdős, open since 1946.

In this talk I will survey some of the progress that has been made since then, including a variety of problems on distinct and repeated distances and other configurations, on incidences between points and lines, curves, and surfaces in two, three, and higher dimensions, on polynomials vanishing on Cartesian products wih applications, on cycle elimination for lines and triangles in three dimensions, on range searching with semialgebraic sets, and I will most certainly run out of time while doing so.

Pierre Simon (Berkeley)
On finite dimensional omega-categorical structures and NIP theories.

The study of omega-categorical structures lies at the intersection of model theory, combinatorics and group theory. Some classes of omega-categorical structures have been classified, most notably stable structures of finite rank (following work of Zilber, Cherlin, Harrington, Lachlan, Hrushovski, Evans) and smoothly approximable structures (Kantor–Liebeck–Macpherson and Cherlin–Hrushovski). We conjecture that the class of structures which have polynomially many types over finite sets, which we will call finite dimensional, can also be classified. We will present results that essentially allow to classify the finite rank case, generalizing what is known for stable structures. The main new ingredient comes from the study of NIP theories and involves coordinatizing structures by linear orders.

Balázs Szegedi (Alfréd Rńyi Institute of Mathematics)
TBD

Caroline Terry (Maryland)
A stable arithmetic regularity lemma in finite-dimensional vector spaces over fields of prime order.

In this talk we present a stable version of the arithmetic regularity lemma for vector spaces over fields of prime order. The arithmetic regularity lemma for $\mathbb{F}_p^n$ (first proved by Green in 2005) states that given $A \subseteq \mathbb{F}_p^n$, there exists $H \leq \mathbb{F}_p^n$ of bounded index such that A is Fourier-uniform with respect to almost all cosets of H. In general, the growth of the index of H is required to be of tower type depending on the degree of uniformity, and must also allow for a small number of non-uniform elements. Our main result is that, under a natural stability theoretic assumption, the bad bounds and non-uniform elements are not necessary. Specifically, we present an arithmetic regularity lemma for k-stable sets $A \subseteq \mathbb{F}_p^n$, where the bound on the index of the subspace is only polynomial in the degree of uniformity, and where there are no non-uniform elements. This result is a natural extension to the arithmetic setting of the work on stable graph regularity lemmas initiated by Malliaris and Shelah.

This is joint work with Julia Wolf.

Todor Tsankov (Université Paris Diderot)
Metrizable universal minimal flows and Ramsey theory.

The connection between Ramsey theory and topological dynamics goes back at least to Furstenberg who used dynamical systems of the group of integers to derive a new proof of Van Der Waerden's theorem. More recently, Kechris, Pestov, and Todorcevic developed a new correspondence between structural Ramsey theory and certain universal dynamical systems of the corresponding automorphism groups. I will survey what is known in the area as well as the most important open questions. I will also discuss some recent generalizations of the framework to the continuous setting.
